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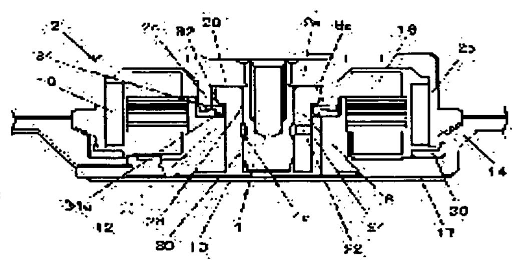
(54) SPINDLE MOTOR

(57)Abstract:
PROBLEM TO BE SOLVED: To effectively prevent flow out of oil to the outside of a bearing, while maintaining a simple and low-priced structure and enabling more miniaturization.
SOLUTION: This spindle motor is provided with a thrust bearing part 20 using oil as a hydraulic fluid thereof between an upper end surface of a sleeve 8 and a bottom surface of a top plate 2a of a rotor 2, and provided with radial bearing parts 28 and 30 using the oil as the hydraulic fluid thereof between the inner peripheral surface of the sleeve 8 and the outer peripheral surface of a shaft 4. The top plate 2a of the rotor 2 is provided with an annular wall part 2c for surrounding a flange part 8a formed in the peripheral surface of the sleeve 8 from the peripheral side, and a tapered seal 32 held by the thrust bearing part 20 and formed with an oil meniscus is formed between the inner peripheral surface of the annular wall part 2c and the outer peripheral surface of the flange part 8a. A fall stopper ring 34 to be engaged with the flange part 8a is installed in the annular wall part 2c.



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CLAIMS

[Claim(s)]
[Claim 1] In the spindle motor which comes to have Rota which consists of a cylinder wall which hangs from the periphery edge of a cylinder-like sleeve, the shaft inserted free [rotation] in this sleeve, this shaft, the circular top plate constituted in one, and this top plate The upper limit side of said sleeve, and the base of the top plate of said Rota While countering through the minute gap where oil is held by capillarity, the upper limit side of said sleeve and the base of a top plate at least to either The slot for dynamic pressure generating which carries out induction of the dynamic pressure to this oil at the time of rotation of said Rota is prepared, and the thrust-bearing section is formed. The inner skin of said sleeve, and the peripheral face of said shaft While countering through the minute gap where oil is held by capillarity, the inner skin of said sleeve and the peripheral face of a shaft at least to either The slot for dynamic pressure generating which carries out induction of the dynamic pressure to this oil at the time of rotation of said Rota is estranged and prepared in the direction of an axis, and the radial bearing section is formed. In said thrust bearing section side edge section of said sleeve The flange in which the peripheral face was formed in the shape of an inclined plane so that the diameter might be reduced as it estranges in the direction of an axis from said thrust bearing section is prepared. To the top plate of said Rota The annular wall which encloses said flange from a periphery side is prepared, and the taper seal with which the meniscus of the oil held at said thrust bearing section is formed between the inner skin of this annular wall and the periphery section of said flange is constituted. The spindle motor characterized by equipping said annular wall with the ****** ring which engages with said flange.
[Claim 2] The annular projected part which protrudes in the direction of an axis is prepared in the radial toe of said ****** ring. Between the inner skin of this annular projected part, and the peripheral face of said sleeve The **** minute gap is formed rather than the gap formed between the engagement sides of said ****** ring and said flange. At the time of rotation of said Rota The gap formed between the engagement sides of said ****** ring and said flange at the minute gap list formed between the inner skin of said annular projected part, and the peripheral face of said sleeve as a labyrinth seal which follows said taper seal The spindle motor according to claim 1 characterized by functioning.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the spindle motor equipped with the hydrodynamic bearing.
[0002]
[Description of the Prior Art] In order to support a shaft and a sleeve member as bearing of a spindle motor from the former, enabling free relative rotation, the hydrodynamic bearing using the fluid pressure of lubrication fluids, such as oil made to intervene among both, is proposed variously.
[0003] The spindle motor which constituted the radial bearing sections e and e between the peripheral faces of Shaft d and the inner skin of Sleeve b which constituted the thrust bearing section c between the base of Rota a and the upper limit side of Sleeve b, and were prepared in Rota a in one was proposed as the applicant of this application showed Japanese Patent Application No. No. (JP,2000-113582,A) 296156 [ten to] etc. to drawing 2 about the spindle motor which uses such a hydrodynamic bearing.
[0004] It is equipped with the ring-like member g into which it fits each other with the step f which formed this spindle motor in the edge of Sleeve b at the free edge of Shaft d further, and the ****** structure of Rota a is constituted by these steps f and the ring-like member g. The buffer oil (oil for a margin) supplied to the gap specified between the perimeter of the ring-like member d and the step f of Sleeve b according to reduction of the oil in the lower part side radial bearing section e is held, and it functions as an oil reservoir.
[0005]
[Problem(s) to be Solved by the Invention] Since the above-mentioned spindle motor does not require the thrust plate which constitutes the thrust bearing section like the conventional hydrodynamic bearing, simplification, low cost-ization, etc. have the merit of becoming possible to thin-shape-ize a motor, having structure of a motor. However, application to small devices, such as a Personal Digital Assistant, is started, and, as for archive-medium driving gears, such as hard disk drive equipment with which such a spindle motor is used, the demand of the further thin-shape-izing is increasing. On the other hand, in the spindle motor illustrated to above-mentioned drawing 2 , since the free edge of Shaft d is equipped with the ring-like member g which constitutes the ****** device of Rota a, there is concern which checks the further thin shape-ization of a motor. This is for requiring a certain amount of distance between bearing, when the bearing rigidity required of the radial bearing sections e and e is taken into consideration.
[0006] Moreover, although the taper seal h is constituted between the annular walls a1 which adjoined the thrust-bearing section c and were formed in the peripheral face of Sleeve b, and Rota a With the taper seal h, although the outflow of the oil as a liquid is prevented by operation of surface tension etc., the oil evaporated by the rise of the external-environment temperature of a motor etc. cannot be held, but it will flow into the bearing exterior slightly as an oil mist.
[0007] Since the outflow of the oil by the oil mist had few amounts, in the spindle motor illustrated by drawing 2 , it did not become a remarkable problem, but since the amount of the oil held by the whole bearing also decreases when it is going to thin-shape-ize a motor further, there is concern which poses a problem which cannot disregard reduction of the oil of oil-mist extent, either. In addition, if lack arises in the amount of maintenance of the oil in bearing, bearing rigidity will fall, it will become difficult for it to be stabilized and to support the posture at the time of rotation of Rota a, and it will become the cause by which NRRO (non-repeatable run-out: non-repeatability deflection) etc. sways, and a surroundings property gets worse.
[0008] this invention is simple -- and -- low cost -- it aims at offering the spindle motor [the further thin-shape-izing is possible, maintaining the structure /-izing / structure /, and] which can prevent the outflow of the oil to the bearing exterior effectively.
[0009]
[Means for Solving the Problem] The shaft by which the spindle motor of this invention is inserted free [rotation] in a cylinder-like sleeve and this sleeve, In the spindle motor which comes to have Rota which

consists of a cylinder wall which hangs from the periphery edge of this shaft, the circular top plate constituted in one, and this top plate The upper limit side of said sleeve, and the base of the top plate of said Rota While countering through the minute gap where oil is held by capillarity, the upper limit side of said sleeve and the base of a top plate at least to either The slot for dynamic pressure generating which carries out induction of the dynamic pressure to this oil at the time of rotation of said Rota is prepared, and the thrust-bearing section is formed. The inner skin of said sleeve, and the peripheral face of said shaft While countering through the minute gap where oil is held by capillarity, the inner skin of said sleeve and the peripheral face of a shaft at least to either The slot for dynamic pressure generating which carries out induction of the dynamic pressure to this oil at the time of rotation of said Rota is estranged and prepared in the direction of an axis, and the radial bearing section is formed. In said thrust bearing section side edge section of said sleeve The flange in which the peripheral face was formed in the shape of an inclined plane so that the diameter might be reduced as it estranges in the direction of an axis from said thrust bearing section is prepared. To the top plate of said Rota The annular wall which encloses said flange from a periphery side is prepared, and the taper seal with which the meniscus of the oil held at said thrust bearing section is formed between the inner skin of this annular wall and the periphery section of said flange is constituted. It is characterized by equipping said annular wall with the ****** ring which engages with said flange (claim 1).
[0010] in this configuration, it is said that the thrust plate which constitutes a thrust hydrodynamic bearing is not required -- simple -- and -- low cost -- the further thin shape-ization of a motor is attained, becoming possible to utilize the overall length of a shaft effectively as bearing, and maintaining bearing rigidity by equipping the annular wall which constitutes a taper seal with the flange of a sleeve with the ****** ring which constitutes ****** of Rota, maintaining the structure [-izing / structure].
[0011] The spindle motor of this invention moreover, in the radial toe of said ****** ring The annular projected part which protrudes in the direction of an axis is prepared. Between the inner skin of this annular projected part, and the peripheral face of said sleeve The **** minute gap is formed rather than the gap formed between the engagement sides of said ****** ring and said flange. At the time of rotation of said Rota The gap formed between the engagement sides of said ****** ring and said flange at the minute gap list formed between the inner skin of said annular projected part and the peripheral face of said sleeve is characterized by functioning as a labyrinth seal which follows said taper seal (claim 2).
[0012] In this configuration, the outflow of the oil to the bearing exterior by the oil mist is more effectively prevented by arranging a labyrinth seal succeeding a taper seal. Moreover, by preparing an annular projected part in a ****** ring, and forming a minute gap between the peripheral faces of a sleeve, since it becomes possible to fully secure the section which functions as a labyrinth seal, even if it is a thin motor, sufficient seal function is maintainable.
[0013]
[Embodiment of the Invention] Although the operation gestalt of the spindle motor concerning this invention is hereafter explained with reference to a drawing, this invention is not limited to the example shown below.
[0014] In drawing 1 this spindle motor Approximate circle board-like upper wall section 2a (top plate), Rota 2 which consists of cylindrical peripheral wall section 2bs which besides hang caudad from the periphery edge of wall 2a, Rota 2 where one edge is constituted from a shaft 4 by which outside attachment immobilization is carried out by the center section of upper wall section 2a of this Rota 2, The seal cap 10 which blockades the bell shape sleeve 8 supported for this shaft 4, enabling free rotation and the lower part of this sleeve 8, and the bracket 14 with which the body 12 by which a sleeve 8 is inner-**(ed) was formed in one are provided. In the base of a seal cap 10 and a bracket 14, the seal member 17 has fixed from the way outside the motor.
[0015] In the periphery side of the body 12 of a bracket 14, a stator 16 is arranged, the inner skin of peripheral wall section 2b of Rota 2 is countered through a gap radial [this / stator 16 and radial], and the Rota magnet 18 fixes.
[0016] The upper limit side of a sleeve 8 counters in the inferior surface of tongue and the direction of an axis of upper wall section 2a of Rota 2 through a minute gap, and oil is held by capillarity all over this minute gap. The spiral slot of the pump in mold which carries out induction of the migration pressure by the side of the method of the inside of radial (shaft 4 side) to oil at the time of rotation of Rota 2 is formed in the inferior surface of tongue of upper wall section 2a facing this minute gap, and the thrust bearing section 20 is constituted.
[0017] The peripheral face of a shaft 4 counters radial [of a sleeve 8 / the inner skin and radial] through a minute gap, and oil is held by capillarity all over this minute gap. The herringbone slot of the pump out mold which have an imbalanced configuration be estrange and form in the direction of an axis which carry out induction of the migration pressure which go to the method of the outside of the direction of an axis (the direction of a vertical edge of a shaft 4) at oil in the direction of an axis by the inner skin of the sleeve 8 which

attend this minute gap at the time of rotation of Rota 2 , and the radial bearing sections 28 and 30 of a pair be constitute .

[0018] So that opening may be carried out to a sleeve 8 in the direction abbreviation center section of an axis of the minute gap formed between the peripheral face of a shaft 4, and the inner skin of a sleeve 8 In the location which the free passage hole 22 which penetrates this sleeve 8 to radial is formed, and counters opening of the free passage hole 22 of shaft 4 peripheral face Annular crevice 4a which consists of an inclined plane of its pair which it-inclines toward the direction opposite side of an axis (the direction of a vertical edge of a shaft 4) is formed. The radial gap dimension of the minute gap between the peripheral face of a shaft 4 and the inner skin of a sleeve 8 is increased gradually toward the method of the inside of the direction of an axis (the direction of the direction center section of an axis of a shaft 4) in this annular crevice 4a from radial bearing section 28 and 30 side.

[0019] In bracket 14 body 12, the direction slot 24 of an axis from the upper limit section of a body 12 to the lower limit section is established in the part corresponding to opening of the free passage hole 22 of sleeve 8 peripheral face, an opening is formed between the body 12 of a bracket 14, and a sleeve 8 of this direction slot 24 of an axis, and the free passage hole 22 is wide opened by the open air. Between annular crevice 4a and the inner skin of a sleeve 8, the gas interstitial segment between which it is placed by the opening formed of the direction slot 24 of an axis and the air which invaded through the free passage hole 22 is formed.

[0020] It dissociates in the direction of an axis and the surface tension of oil, an outside atmospheric pressure, etc. balance all over the gap where a gap dimension radial [between the inclined planes of a pair and the inner skin of a sleeve 8 which constitute annular crevice 4a] changes gradually, the interface of oil and the air held at a gas interstitial segment is formed in the shape of a meniscus of this gas interstitial segment, respectively, and the oil held at the radial bearing sections 28 and 30 of a pair is held.

[0021] Between the thrust bearing sections 20 which adjoin the up radial bearing section 28 constituted among the radial bearing sections 28 and 30 of a pair at the upper part side of a gas interstitial segment, and this, oil is held continuously. In order that the thrust-bearing section 20 and the up radial bearing section 28 may carry out induction of the migration pressure which acts in the direction of other party bearing which adjoins, respectively to oil as above-mentioned, a pressure peak is generated in near the upper limit section of the boundary section of both bearings, i.e., the inner skin of a sleeve 8.

[0022] That is, when the thrust-bearing section 20 and the up radial bearing section 28 collaborate, the shaft bearing capacity which acts on radial [over Rota 2], and the axial bearing capacity of the direction of an axis which acts in the direction which surfaces to a bracket 14 are given.

[0023] The thrust yoke 38 of the shape of a circular ring formed in the location which counters in the inferior surface of tongue and the direction of an axis of the Rota magnet 18 from the ferromagnetic ingredient is arranged, and bias of Rota 2 will be magnetically carried out to a bracket 14 in the direction of an axis by the magnetic-attraction force produced between this thrust yoke 38 and the Rota magnet 18. The surfacing force of Rota 2 generated because the magnetic force, and the thrust-bearing section 20 and the up radial bearing section 28 of the direction of an axis which acts on this Rota 2 collaborate balances, the load to the direction both sides of an axis to Rota 2 is supported, and the posture under rotation of Rota 2 will be stabilized and will be maintained. In addition, it is also possible to generate the magnetic-attraction force over Rota 2 by arranging so that it may replace with a bracket 14 at the configuration which arranges a thrust yoke 38, for example, the magnetic core of the Rota magnet 18 and a stator 16 may be mutually displaced in the direction of an axis.

[0024] Annular flange 8a formed in the shape of an inclined plane so that the diameter might be reduced as it protrudes on the method of the outside of radial and a peripheral face estranges from the thrust bearing section 20 is prepared in the upper limit section of the peripheral face of a sleeve 8. Moreover, annular wall 2c which has the peripheral face of this flange 8a and the inner skin which counters radial in the state of non-contact is formed in the inferior surface of tongue of upper wall section 2a of Rota 2.

[0025] The radial gap dimension of the gap specified between the inner skin of this annular wall 2c and the peripheral face of flange 8a is formed in the shape of an inclined plane as the peripheral face of flange 8a is the above, and it is increased gradually in the shape of a taper toward the method of the inside of the direction of an axis (the direction of a point of annular wall 2c). That is, in the radial heel of the thrust-bearing section 20, the inner skin of this annular wall 2c and the peripheral face of flange 8a collaborate, and the taper seal section 32 is constituted. In this taper seal section 32, the surface tension of oil and an outside atmospheric pressure balance, and, as for the oil held at the thrust bearing section 20, the interface of oil and air is formed in the shape of a meniscus.

[0026] The interface of the oil by the side of the up radial bearing section 28 which follows the interface of the oil by the side of these thrust-bearings section 20 and air and this, and air functions as maintain the condition

that it will be hold in the location where pressures, such as an outside atmospheric pressure which acts on both the interfaces in each gap where the radial dimension in which each interface is form changes, balance, and oil was always held at bearing.
[0027] That is, the gap between these tapers seal section 32 and annular crevice 4a, and the inner skin of a sleeve 8 functions as an oil reservoir, and the oil held in these gaps acts as buffer oil of the thrust-bearing section 20 and the up radial bearing section 28.
[0028] In addition, in order for the thrust-bearing section 20 and the up radial bearing section 28 by which oil is held continuously to collaborate and to acquire axial bearing capacity as above-mentioned, it is only one point that a pressure peak occurs among both bearings at the time of rotation of Rota 2. Since it becomes low voltage as it tends toward the interface of oil and air, the air bubbles intermingled in oil will move to both the interface side one by one, and will be wide opened in air.
[0029] In the point of annular wall 2c, the ****** ring 34 has fixed with means, such as a caulking. Rota 2 to a sleeve 8 escapes from this ****** ring 34 by fitting in each other in the state of flange 8a and non-contact, and stop structure is constituted. Thus, alignment arrangement of the radial bearing sections 28 and 30 and ****** structure of a pair is not carried out on the same line in the direction of an axis with constituting the ****** structure of Rota 2 in the peripheral face side of a sleeve 8. Therefore, it becomes possible to utilize the overall length of a shaft 4 effectively as bearing, and thin shape-ization of the further motor is realized, maintaining bearing rigidity.
[0030] The ****** ring 34 has countered through the gap of the direction of an axis which follows the inferior surface of tongue and the taper seal section 32 of flange 8a, and has a **** gap dimension rather than the radial gap dimension of the taper seal section 34. Furthermore, annular projected part 34a which projects toward the direction center section of an axis of the sleeve 8 is prepared in the radial toe of the ****** ring 34. The inner skin of this annular projected part 34a and the peripheral face of a sleeve 8 have countered through the radial minute gap which has a still more **** gap dimension rather than the clearance between the directions of an axis specified between the ****** ring 34 and the inferior surface of tongue of flange 8a.
[0031] By setting up as small as possible the gap dimension of the radial minute gap specified between the inner skin of annular projected part 34a, and the peripheral face of a sleeve 8 A difference with the rate of flow of the air in the gap of the direction of an axis specified between the rates of flow of air, the taper seal sections 32 and the ****** rings 34, and flange 8a in a minute gap radial [this] at the time of rotation of a spindle motor becomes large. Effluent resistivity to the exterior of the steam produced when oil evaporated is enlarged, and vapor pressure [/ near the interface of oil] is kept high, and it functions as a labyrinth seal so that evapotranspiration of the further oil may be prevented.
[0032] Thus, the outflow of the oil as a liquid is not only prevented, but it becomes possible by allotting a labyrinth seal succeeding the taper seal section 32 to also prevent the outflow to the motor exterior of the oil mist generated because oil evaporates by the rise of the external-environment temperature of a motor etc. Therefore, the bearing engine performance stabilized over the long period of time can be maintained, and it can consider as bearing with high endurance and dependability.
[0033] It becomes possible to fully secure the section which functions as a labyrinth seal by preparing annular projected part 34a in the ****** ring 34, and forming a minute gap between the peripheral faces of a sleeve 8. For this reason, even if it is a thin motor, sufficient seal function is secured.
[0034] As mentioned above, although 1 operation gestalt of the fluid hydrodynamic bearing according to this invention was explained, various deformation thru/or corrections is possible for this invention, without not being limited to this operation gestalt and deviating from the range of this invention.
[0035]
[Effect of the Invention] it is said that the spindle motor of claim 1 of this invention does not take the thrust plate which constitutes a thrust hydrodynamic bearing -- simple -- and -- low cost -- the further thin shape-ization of a motor is attained, maintaining bearing rigidity, maintaining the structure [-izing / structure].
[0036] In the spindle motor of claim 2 of this invention, while becoming possible to maintain the bearing engine performance which the outflow of the oil by the oil mist to the bearing exterior was more effectively prevented, and was stabilized over the long period of time, even if it is a thin motor, sufficient seal function is maintainable.

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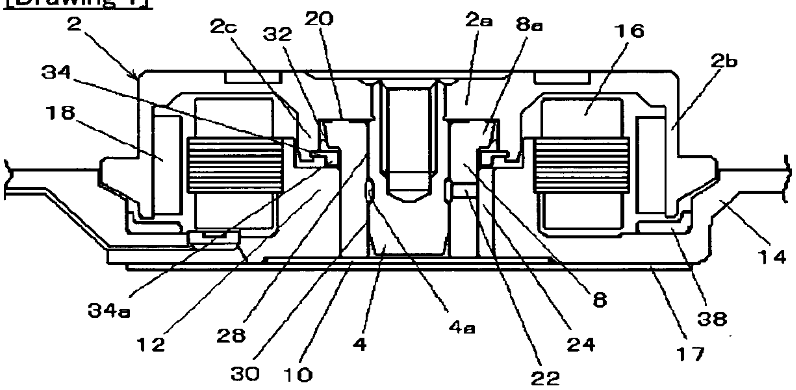
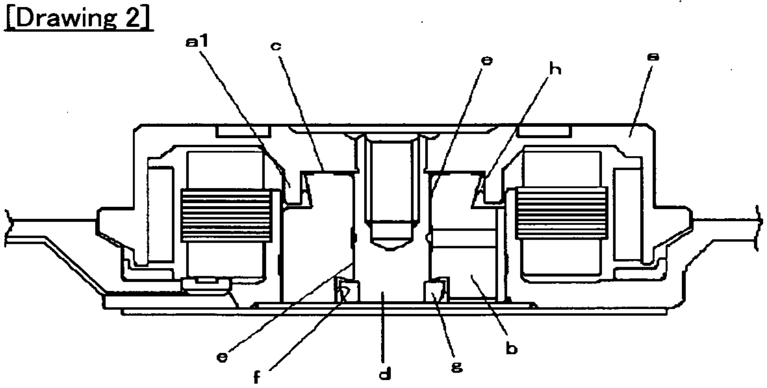
DRAWINGS

[Drawing 1]



[Drawing 2]



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